


The Association of Adverse Childhood Experiences and Resilience With Health Outcomes in Adolescents: An Observational Study

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Abstract

The relationship between Adverse childhood experiences (ACEs), resilience, and health outcomes has not been as thoroughly studied in adolescents. Adolescents completed the ACEs Questionnaire and a validated resilience measure (Child Youth Resilience Measure, or CYRM). Poor health outcome was having 1 or more: obesity, hypertension, and/or depression. 34.5% of teens had a poor health outcome, 38.6% had ACE scores of 4 or more, and resilience ranged from 45 to 84 (mean=74.6). By univariate and bivariate analysis, ACEs (OR = 1.11, 95% CI = 1.03-1.19, $P = .0039$; OR = 1.08, 95% CI = 1.0-1.16, $P = .045$) and resilience (OR = 0.95, 95% CI = 0.92-0.98, $P = .0016$; OR = 0.96, 95% CI = 0.93-0.99, $P = .016$) were significantly associated with poor health outcome. Resilience relationship subscale was significantly associated with reduced health risk (OR = 0.85, 95% CI = 0.75-0.95, $P = .005$). ACEs are associated with poor health outcomes in adolescents, resilience is inversely related, and the caregiver relationship may be the driving force.

Keywords

ACEs, adverse childhood experiences, resilience, adolescent, caregiver relationship

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What do we already know about this topic?

A higher number of adverse childhood experiences, or ACEs, has been shown to negatively impact an individual's health. Resilience has been proposed to be a protective factor against the trauma of ACEs.

How does this research contribute to the field?

This study helps to concretely link and better define the relationship between ACEs, health, and resilience showing that resilience is inversely related to poor health outcomes in adolescents and the relationship with their caregiver may be the driver of this protective relationship.

What are the research's implications toward theory, practice, or policy?

These observations suggest that future interventions aimed at strengthening and supporting resilience, and particularly the relationship between the adolescent and their caregiver may improve health outcomes among teens at high risk of ACEs.

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Introduction

Adverse Childhood Experiences, or ACEs, are different types of stressful events in childhood that have been shown to have a long-lasting impact on health outcomes, even into adulthood. Research has shown that exposure to 4 or more ACE categories predicts a higher risk of physical and mental health complications.¹⁻⁵ It is thought that the buildup of stressful events, like ACEs, experienced by a child can lead to toxic stress, or wear and tear on the developing brain and stress response system of the child.⁶⁻⁸ Studies in children and adolescents who have undergone traumatic experiences have shown dysregulation in how their brain and body interpret and respond to stress.⁹⁻¹⁷

The initial ACE study included 7 categories of ACEs which were then ultimately increased to the 10 traditional ACE questions.¹ Since that time additional categories have been proposed to encompass experiences of individuals living in diverse urban environments that were not captured in the original ACE questions. These additional ACE questions, including experiences like exposure to community violence, racism, foster care, bullying, and separation through deportation or immigration, while not accepted as part of the traditional 10 ACEs, are often now included as part of Expanded ACEs screening questions.¹⁸⁻²⁰

In spite of the known impact of childhood stress on long term health, there are still children who succeed despite difficult circumstances, which has led to the concept of resilience. Windle et al,²¹ in a synthesis of over 270 articles, define resilience as, “the process of negotiating, managing, and adapting to significant sources of stress or trauma. Assets and resources within the individual, their life and environment facilitate this capacity for adaptation and ‘bouncing back’ in the face of adversity”. Current data suggests that resilience is a dynamic strengths-based characteristic that can be developed and changed over time and in different contexts.²²⁻²⁵ Several factors, such as a stable relationship with a caring adult, belief in one’s own capability and feeling a sense of mastery over circumstances, developing executive functions and self-regulation, and faith or cultural traditions, have been found to promote higher levels of resilience.²⁶⁻²⁸

Increased resilience has been reported to be associated with lower rates of mental and physical health problems as well as lower rates of inflammatory markers, suggesting higher resilience may be protective against the detrimental effects of ACEs.²⁹⁻³³ While the understanding of the commonality of resilience has improved, the concept itself is complex and difficult to measure and many studies rely on patient or parent self-reports of health. This study serves to fill a gap of

concretely linking and better defining the relationship between ACEs, health, and resilience. Our primary hypothesis is that in adolescents: (1) resilience will mitigate, to some extent, the adverse effects of ACEs on health outcomes. Secondary hypotheses include: (1) higher ACE scores will be associated with worse health outcomes in adolescents; (2) higher resilience scores will be associated with better health outcomes in adolescents; (3); and resilience will have an inverse relationship with ACE scores.

Methods

Patients

All individuals 12 to 18 years of age presenting for a preventative care visit at an urban academic pediatric practice were eligible for enrollment. Exclusion criteria included patients under the age of 18 years who were not accompanied by a parent or legal guardian, individuals whose primary reading/writing language was not English or Spanish, and adolescents who were not able to complete the self-report questionnaires on their own were excluded. Consent of a parent or legal guardian as well as assent of the adolescent was obtained prior to participation.

Data Collection

Each adolescent completed 2 questionnaires on a tablet device with the data collected digitally through Redcap. All forms were completed by the adolescent with no information collected from the parent. The Adverse Childhood Experiences Questionnaire (ACE-Q), developed by the Center for Youth Wellness in San Francisco, California, is a clinical screening tool that assesses lifetime exposure to ACEs for children.³⁴ The teen self-report, version includes 19 categories: the 10 traditional ACEs as well as 9 expanded ACEs assessing exposure to community adversity. A total score of 4 or more is considered significant. The 10 traditional ACEs, the 9 expanded ACEs, and the ACE total score were extracted separately.

The Child Youth Resilience Measure (CYRM) is a 28-item, validated measure of the individual, relational, communal, and cultural resources available to the adolescent that are associated with increased resilience.^{35,36} This tool is unique as it was developed in 14 communities across 11 countries and 11 different languages making it more culturally relevant to a broader group of people. Developed as a screening tool for youth aged 10 to 23 years, the survey is available with a 3-point or a five-point scale. For this study, the three-point scale was used with a maximum score of 84. There are no

reference cutoffs; higher scores denote higher levels of resilience. In addition to an overall resilience score, the tool allows for breakdown into 3 sub-scales, individual, relationship with caregiver, and context, permitting examination of different resilience components. The individual subscale examines personal and social skills like finishing what you start and how you act when something doesn't go your way. The relationship with the caregiver subscale focuses on physical aspects of caregiving, like having enough food and feeling like your caregiver knows where you are and what you are doing, along with psychological aspects such as feeling like your caregiver knows about you and cares about you, and if you can talk to your family about how you feel. The context subscale examines spiritual, educational, and cultural contexts like participation in religious or community activities and feeling one is treated fairly in his or her community.³⁵

Outcome Measures

As part of each preventative care visit, height, weight and blood pressure were recorded and the 6-item Kutcher Depression Scale was completed.³⁷ Health outcome for this study was having 1 or more health outcomes, either obesity (BMI at or greater than the 95th percentile for age), hypertension (systolic and/or diastolic blood pressure greater than or equal to the 95th percentile for age) or depression (a score of 6 or higher on the depression scale). BMI and blood pressure were chosen as they are done at all routine adolescent visits and are known predictors of future health outcomes like heart disease. The Kutcher Depression Scale was used as that is what is currently used for depression screening of adolescents in this clinic. Having any 1 of these 3 adverse health outcomes defined a poor health outcome. As obesity was the most prevalent of the 3 outcomes measured, obesity was analyzed as a separate outcome measure in addition to the composite poor health outcome.

Data Analysis

All analyses were performed in the R environment. Correlation matrices among the 3 ACEs scales were calculated using the Pearson correlation coefficient; values greater than 0.75 were considered highly correlated. For regression problems, univariate and multivariate analyses were performed using ordinary least squares regression. For classification problems, optimization was performed using iteratively reweighted least squares and calculation of the logit function. The z statistic was calculated for each regression and classification analysis and *P* values <.05 were considered significant.

Ethical Approval and Informed Consent

This study was approved by the Institutional Review Board for Human Investigation at Temple University (Reference #24871). Consent of a parent or legal guardian as well as assent of the adolescent was obtained prior to participation.

Results

Of the 450 adolescents enrolled, 7 had incomplete data. Participants ranged from 12.1 to 18.9 years old with a mean age of 14.9 years old. About 55% of the sample were female, 72.5% identified as African American and 21.1% identified as Hispanic. One-fifth of adolescents (20.3%) reported exposure to 4 or more of the traditional ACEs, about 5% (4.7%) reported exposure to 4 or more expanded ACEs, and 38% of adolescents (38.6%) reported exposure to 4 or more total ACEs. (Table 1). Since the total ACE score correlated strongly with traditional ACEs ($R=0.92$) and expanded ACEs ($R=0.76$), total ACE score was used for all of the analyses. Resilience scores ranged from 45 to 84 with a mean of 74.6. Over a third of adolescents (34.5%) had at least 1 poor health outcome with obesity being the most prevalent (24.6%) followed by depression (12.6%) (Table 1).

By univariate analysis, total ACE scores and resilience were significantly associated with poor health outcomes (OR = 1.11, 95% CI = 1.03-1.19, $P=0.0039$ and OR = 0.95, 95% CI = 0.92-0.98, $P=.0016$, respectively). Both total ACE score and resilience were independent predictors of poor health outcomes in a bivariate model (OR = 1.08, 95% CI = 1.0-1.16, $P=.045$ and OR = 0.96, 95% CI = 0.93-0.99, $P=.016$, respectively); however, both factors were statistically insignificant when an interaction term was included in the model: total ACE score: OR = 1.85, 95% CI = 0.82-4.50, $P=.157$; resilience: OR = 0.98, 95% CI = 0.93-1.04, $P=0.524$; interaction: OR = 0.99, 95% CI = 0.98-1.00, $P=.211$ (Table 2). The same analyses were run with obesity and neither ACEs nor resilience were predictors of obesity in univariate or bivariate models. Due to lack of significance, only the composite poor health outcome was used for further analysis.

By univariate analysis with total ACE score as the response variable, total resilience (OR = -0.15, 95% CI = -0.19 to -0.11, $P\leq .0001$) as well as each of the resilience subscales (individual subscale: OR = -0.18, 95% CI = -0.27 to -0.08, $P=.0002$; relationship subscale: OR = -0.67, 95% CI = -0.81 to -0.52, $P\leq .0001$; context subscale: OR = -0.29, 95% CI = -0.37 to -0.19, $p\leq .0001$) were inversely predictive. Multivariate analysis using only the resilience subscales as predictive variables demonstrated that the relationship subscale (OR = -0.62, 95% CI = -0.80 to -0.43, $P\leq .0001$) and

Table 1. ACEs, Resilience, and Adolescents.
Demographic Data (n = 443)*.

Age	Min	12.1 years	
	Max	18.9 years	
	Mean	14.9 years	
	IQR	13.4–16.5 years	
Gender (% female)	244 (55%)		
Race			
	African American	321 (72.5%)	
	Hispanic	93 (21.1%)	
	Other	23 (5.1%)	
	White	5 (1.1%)	
	Asian	1 (0.2%)	
Prevalence of ACEs			
	0 ACEs	1–3 ACEs	4 or more ACEs
Traditional	113 (25.5%)	240 (54.2%)	90 (20.3%)
Expanded	122 (27.5%)	300 (67.7%)	21 (4.7%)
Total	57 (12.9%)	215 (48.5%)	171 (38.6%)
Resilience scores			
	Min	45.0	
	Max	84.0	
	Mean	74.6	
	IQR	71.0–79.0	
Prevalence of adverse health outcomes			
	At least 1 positive outcome	153 (34.5%)	
	Obesity	109 (24.6%)	
	Depression	56 (12.5%)	
	Systolic HTN	11 (2.5%)	
	Diastolic HTN	4 (0.9%)	

*n = 443, original data included 450, 7 not included due to incomplete data.
ACEs = adverse childhood experiences.

Table 2. ACEs, Resilience, and Adolescents.
Prediction of Composite Health Risk * by ACEs Total and Resilience Score.

	OR	95% CI	P value
Univariate			
ACEs total	1.11	1.03–1.19	0.0039
Resilience	0.95	0.92–0.98	0.0016
Multivariate			
ACEs total	1.08	1.00–1.16	0.045
Resilience	0.96	0.93–0.99	0.016
ACEs total, resilience, and interaction term			
ACEs total	1.85	0.82–4.50	0.157
Resilience	0.98	0.93–1.04	0.524
Interaction	0.99	0.98–1.00	0.211

*Health risk = having at least 1 of 3 outcomes, obesity, hypertension, or positive depression score.
ACEs = adverse childhood experiences.

the context subscale (OR = -0.11, 95%CI = -0.22 to -0.0004, $P = .042$) were significantly associated with reductions in total ACEs (Table 3).

By univariate analysis, the resilience relationship subscale (OR = 0.85, 95% CI = 0.75–0.95, $P = .005$) and the context subscale (OR = 0.93, 95%CI = 0.86–0.99,

Table 3. ACEs, Resilience, and Adolescents.
Association of ACEs Total Score with Resilience.

	OR	95% CI	P value
Univariate			
Resilience total	-0.15	-0.19 to -0.11	<.0001
Individual subscale	-0.18	-0.27 to -0.08	.002
Relationship subscale	-0.67	-0.81 to -0.52	<.0001
Context subscale	-0.29	-0.37 to -0.19	<.0001
Multivariate			
Individual subscale	0.68	-0.38 to 0.17	.209
Relationship subscale	-0.62	-0.80 to -0.43	<.0001
Context subscale	-0.11	-0.22 to -0.0004	.042

ACES=adverse childhood experiences.

Table 4. ACEs, Resilience, and Adolescents.
Association of Health Outcomes with ACEs Total and Relationship Subscale.

	OR	95% CI	P value
Univariate			
Relationship subscale	0.85	0.75–0.95	0.005
Context subscale	0.93	0.86–0.99	0.035
Bivariate—relationship and context subscales			
Relationship subscale	0.87	0.75–1.00	0.046
Bivariate ACEs and relationship subscale			
ACES total	1.08	1.00–1.16	0.052
Relationship subscale	0.89	0.78–1.01	0.064

ACES=adverse childhood experiences.

$P=.035$) were significantly associated with poor health outcomes; only the relationship subscale was significantly associated with poor health outcomes in a model containing both subscales (OR=0.87, 95%CI=.75-1.00, $P=.046$). In a bivariate analysis with total ACE scores and the relationship subscale as predictors of poor health outcomes, both factors were not statistically significant: ACEs Total (OR=1.08, 95%CI=1.00-1.16, $P=.052$); Relationship subscale (OR=0.89, 95% CI=0.78-1.01, $P=0.064$; Table 4).

Discussion

Since the original Adverse Childhood Experiences study was published over 20 years ago, a multitude of other studies have affirmed their findings of the impact on long-term health, including in children and adolescents.^{16,38-46} Our study affirms the established association of ACEs with poor health outcomes in adolescents when looking at a composite measure of poor health, having either obesity, hypertension, or depression.

Resilience has been reported to be associated with lower prevalence of health problems in adults and

adolescents, such as depression, obesity, hypertension, and general reports of poor health.^{29-33,47-53} While these studies suggest that higher resilience may be protective against the toxic stress of ACEs, each study employed different definitions of resilience and used different tools to measure it. One study used a single question to infer resilience.⁵³ Our study used a validated resilience measure to extend this inverse relationship between resilience and poor health outcomes in adolescents. In addition, several of the above studies used patient self-report of overall health and medical conditions, while we used objective health outcomes measured at the time of participation.

The validated resilience measure that was used in this study not only gives a total resilience score but also allows for further analysis of 3 different components of resilience; individual, relationship with a caregiver, and context subscales. In this study both the relationship and the context subscales were inversely related to ACEs and were significant predictors of health outcomes. When both subscales were included in analysis, only the relationship subscale was significant suggesting this is the driver of the protective nature of resilience.

Understanding which components of resilience are most significant in different age groups can help focus interventions. In the case of adolescents, focusing on their relationship with their primary caregiver will likely have the most benefit, affirming the belief that support of a stable caregiver is one of the most important factors for children's development of resilience.^{27,54,55}

In aggregate, previous studies suggest that positive supports in an individual's life counteract the negative impact of stressful experiences on one's health. The present study extends these observations to adolescents in a high risk urban area. Moreover, using validated instruments it was shown that: (1) higher ACE scores are associated with a higher risk of negative health outcomes; (2) higher resilience scores are associated with lower risk of negative health outcomes (obesity, hypertension, and/or depression); (3) ACEs and resilience have an inverse relationship; and (4) the relationship with caregiver resilience subscale is the primary driver of protective nature of resilience in adolescents.

This study has several limitations. First, the generalizability of these findings to a broader population may be limited since the observations were derived from minority teens in an urban, low socioeconomic environment. Health outcomes were measured at a single point in time. It is not known if the protective aspect of resilience holds up over time, overcomes future ACEs or if health outcomes change longitudinally. Using a composite of poor health outcomes limits extending the relationship with ACEs and resilience to one specific health outcome. Obesity was disproportionately represented as an adverse health outcome precluding subset analyses for hypertension and to a lesser extent depression. Individual health outcomes were not significant likely due to the study being under powered. We also did not include other health outcomes that have been found to be associated with ACEs. Selection bias is a possible confounder since all adolescents attending preventative visits were eligible but not all chose to participate. Reporting bias can also be a significant issue since resilience and ACEs were both self-reported but not verified.

Conclusion

Among urban adolescents, higher ACE scores are associated with higher rates of poor health outcomes, namely obesity, depression, and/or hypertension. In the same group of patients, higher resilience scores are associated with lower rates of poor health outcomes. Furthermore, there is evidence that higher resilience scores are associated with lower ACE scores and, in turn, lower rates of negative health outcomes when the

2 factors are considered together. Finally, analysis of the components of resilience suggest that the relationship between the adolescent and their caregiver is the primary driver of the protective nature of resilience, deserving further study. These observations suggest that future interventions aimed at strengthening and supporting the relationship between the adolescent and their caregiver may improve health outcomes among teens at high risk of ACEs.

Author Contributions

Dr. Hall and Dr. Aronoff conceptualized and designed the study, carried out data analysis, drafted the initial manuscript, and reviewed and revised the manuscript.

Alberly Perez and Xandria West designed the data collection instruments, coordinated and supervised data collection, collected data, and reviewed and revised the manuscript.

Marylyn Brown, Ella Kim, and Zainab Salih collected data and reviewed and revised the manuscript.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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This study was approved by the Institutional Review Board for Human Investigation at Temple University (Reference #24871). Consent of a parent or legal guardian as well as assent of the adolescent was obtained prior to participation.

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